WHAT IS CLAIMED IS:

1. A method of manipulating mesoscopic particles, comprising the steps of:

providing a beam of light whose wavefronts are at least approximately planar;

focusing the beam of light with a lens with a sufficiently large numerical aperture to create a single-beam gradient-force optical trap having a transverse optical gradient component; and

using the optical trap to exert forces transverse to the optical axis of the beam of light.

2. The method of claim 1, further comprising the step of modifying the properties of the focused beam of light with a phase modulation.

3. The method of claim 1, where the beam of light is a laser beam.

4. The method of claim 2, wherein the phase modulation is $\varphi(\vec{r})$ and $\vec{r}$ is the position relative to the axis of the beam of light in a plane transverse to the direction of propogation.

5. The method of claim 1, wherein forces exerted by the optical trap transport mesoscopic matter.

6. The method of claim 4, wherein the mesoscopic matter comprises nanoclusters.

7. The method of claim 4, wherein the mesoscopic matter comprises collodial particles.

8. The method of claim 4, wherein the mesoscopic matter comprises biological cells.

9. A method of correcting aberrations that appear in an optical train defining an optical trapping system, comprising the steps of:

locating an optical axis onto a monitoring device;

establishing the geometry of the optical trapping system;

locating the optical axis on a spatial light modulator;

measuring the effective input aperture relative to the optical axis on the spatial light modulator;

measuring any aberrations that appear in the optical train; and

correcting the measured aberrations that appear in the optical train.

10. The method of claim 9, wherein the monitoring device comprises a video camera.

11. The method of claim 10, wherein the measured aberrations are corrected by realigning the optical train.

12. The method of claim 9, wherein the measured aberrations are corrected by the steps of:

calculating a compensating phase mask; and

combining the compensating phase mask with kinoforms encoding patterns of traps to correct the aberrations.

13. The method of claim 12, wherein the complexity of the compensating phase mask is measured to determine whether the optical train requires realignment.

14. The method of claim 9, wherein the measured aberrations are selected from the group consisting of spherical aberrations, comas, astigmatisms, field curvatures, distortions and combinations thereof.

15. The method of claim 9, wherein the aberrations are measured using a computer imaging system.

16. The method of claim 9, wherein the geometry of the optical trapping system is identified by the steps of:

sending a kinoform to the spatial light modulator;

encoding an array of traps; and

imaging the resulting intensity in the focal plane.

17. The method of claim 9, wherein the geometry of the optical trapping system is identified by measuring the positions of each projected trap based upon the center of intensity for each focused spot of light.

18. The method of claim 9, wherein the optical axis is located onto the monitoring device by sending a uniform phase pattern to the spatial light modulator, causing the spatial light modulator to project an undiffracted beam onto a mirrored surface, which reflects the beam to the monitoring device, wherein the location of the beam on the monitoring device defines the location of the optical axis.

19. The method of claim 18, wherein the beam comprises a laser beam.

20. The method of claim 19, wherein the laser beam's intensity is adjusted such that an undiffracted region appears on the monitoring device without saturating the monitoring device.